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(54) **COMPONENT IDENTIFICATION AND TRACKING SYSTEM FOR TELECOMMUNICATION NETWORKS**

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(Continued)

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CPC ***G06F 17/30879*** (2013.01); ***H04Q 1/136*** (2013.01); ***H04L 41/0253*** (2013.01); ***H04L 41/12*** (2013.01); ***G06F 17/30876*** (2013.01)

(58) **Field of Classification Search**
CPC G06Q 10/0833; G06K 9/00442; G06K 9/6202; G09F 3/0297; G06F 17/30879; G06F 17/30876; H04L 2209/805; H04W 4/008; G01J 3/0262; G01J 3/18; G01J 3/2803
USPC 235/375, 451, 492, 462.01; 340/10.1, 340/572.1, 572.2
See application file for complete search history.

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(Continued)

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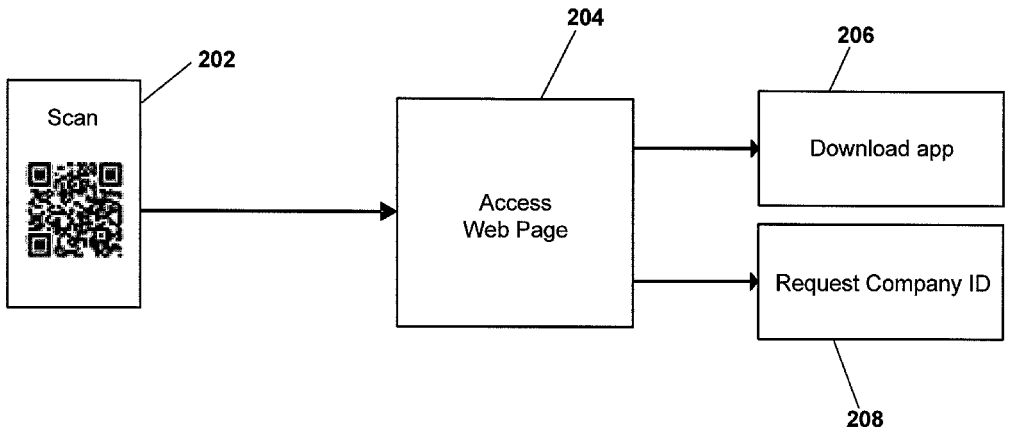
(74) *Attorney, Agent, or Firm* — Merchant & Gould P.C.

(57) **ABSTRACT**

Identification elements (e.g., tracking elements, tracing elements, locating elements, etc.) (**22A**, **100**) are provided on various communication components (**20**, **24**, **26**, **28**, **30**, **32**, **34**, **35**, **36**, **40**, **42**, **48**, **49**, **60**, **62**, **64**, **120**) provided within a communication network such as a fiber optic network or a copper network. Fiber optic hubs **20** can be identified and/or managed. Data centers (**110**) with patch panels (**120**) can also be identified and/or managed. Example passive identification elements include bar codes (e.g., 2d barcodes) and radio frequency identification (RFID) tags. In certain embodiments, RFID tags and the bar codes can include network information included therein. In certain embodiments, bar codes can be used to direct technicians to network links at which additional information stored elsewhere is provided. In certain embodiments, identification elements can be provided on communication components through an application downloaded to a mobile device by scanning the bar code. Such application on the mobile device can then be used to manage the network connections, change the network connections, or check the status of the network connections. Multiple mobile devices can be used and synchronized together with a central application, website or network. One example bar code useful for reading information from a network device and linking to a management application is a QR code (**100**).

16 Claims, 4 Drawing Sheets



(51) **Int. Cl.**

G06K 7/08	(2006.01)
G06K 7/10	(2006.01)
G06F 17/30	(2006.01)
H04Q 1/02	(2006.01)
H04L 12/24	(2006.01)

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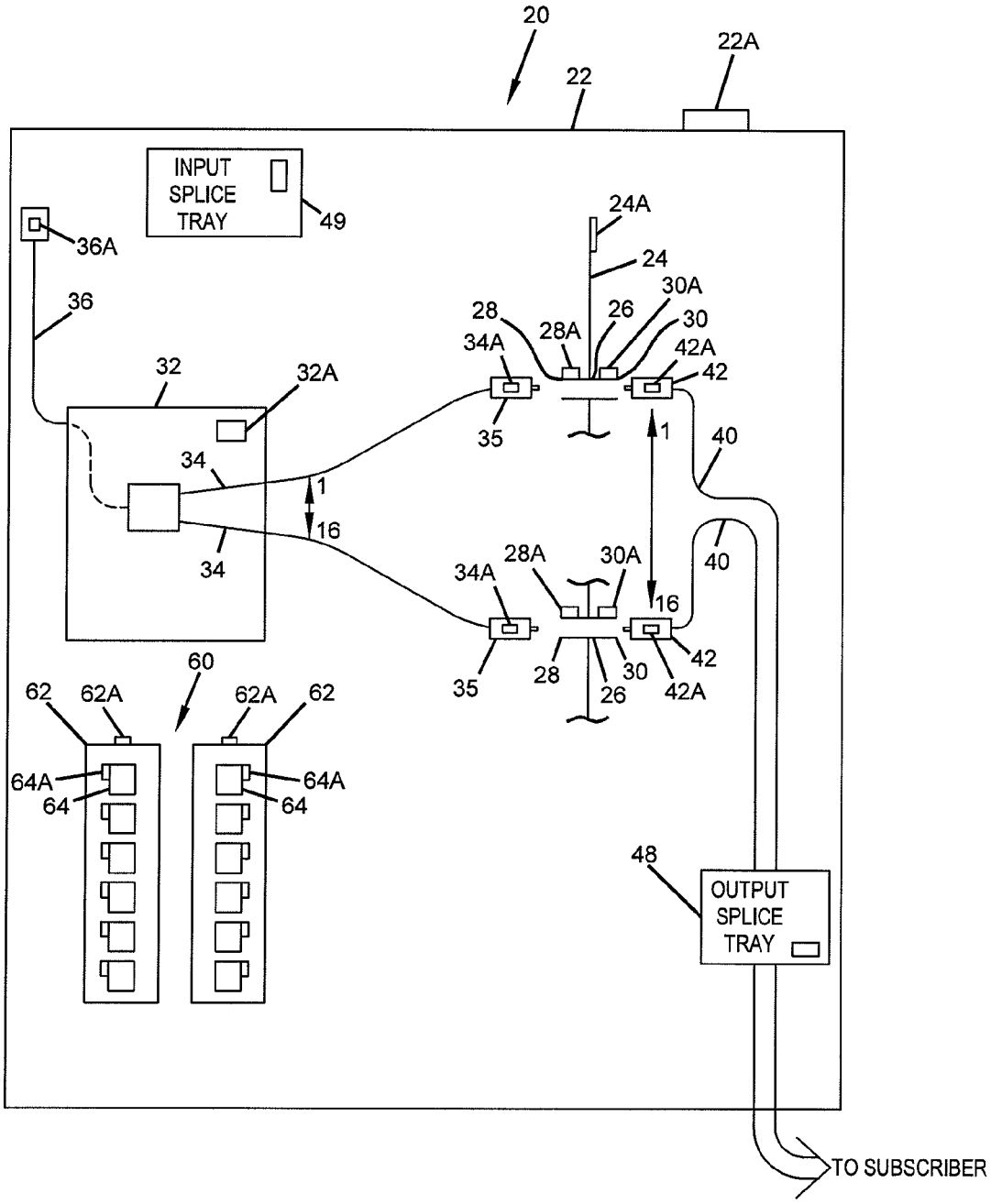
FIG. 1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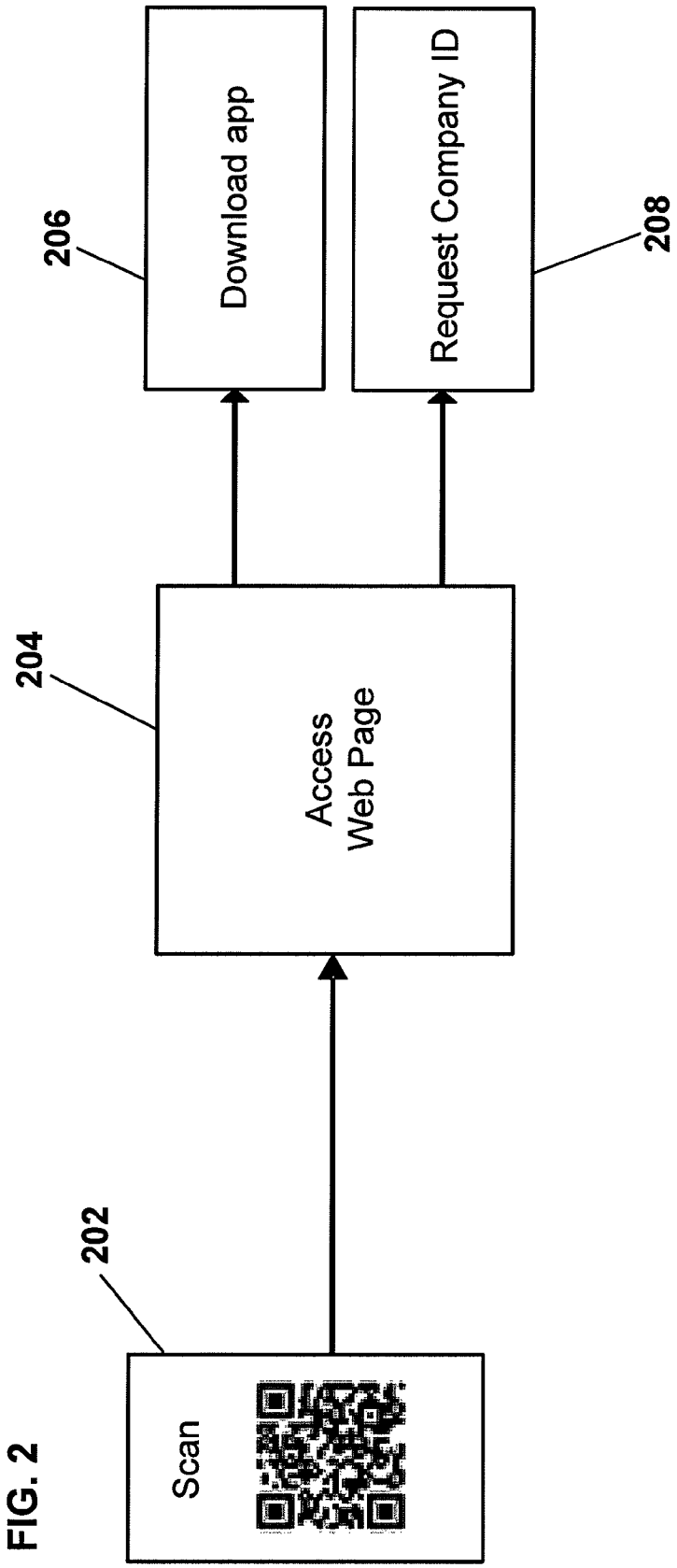
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Request Company ID
206
208
204
Access Web Page
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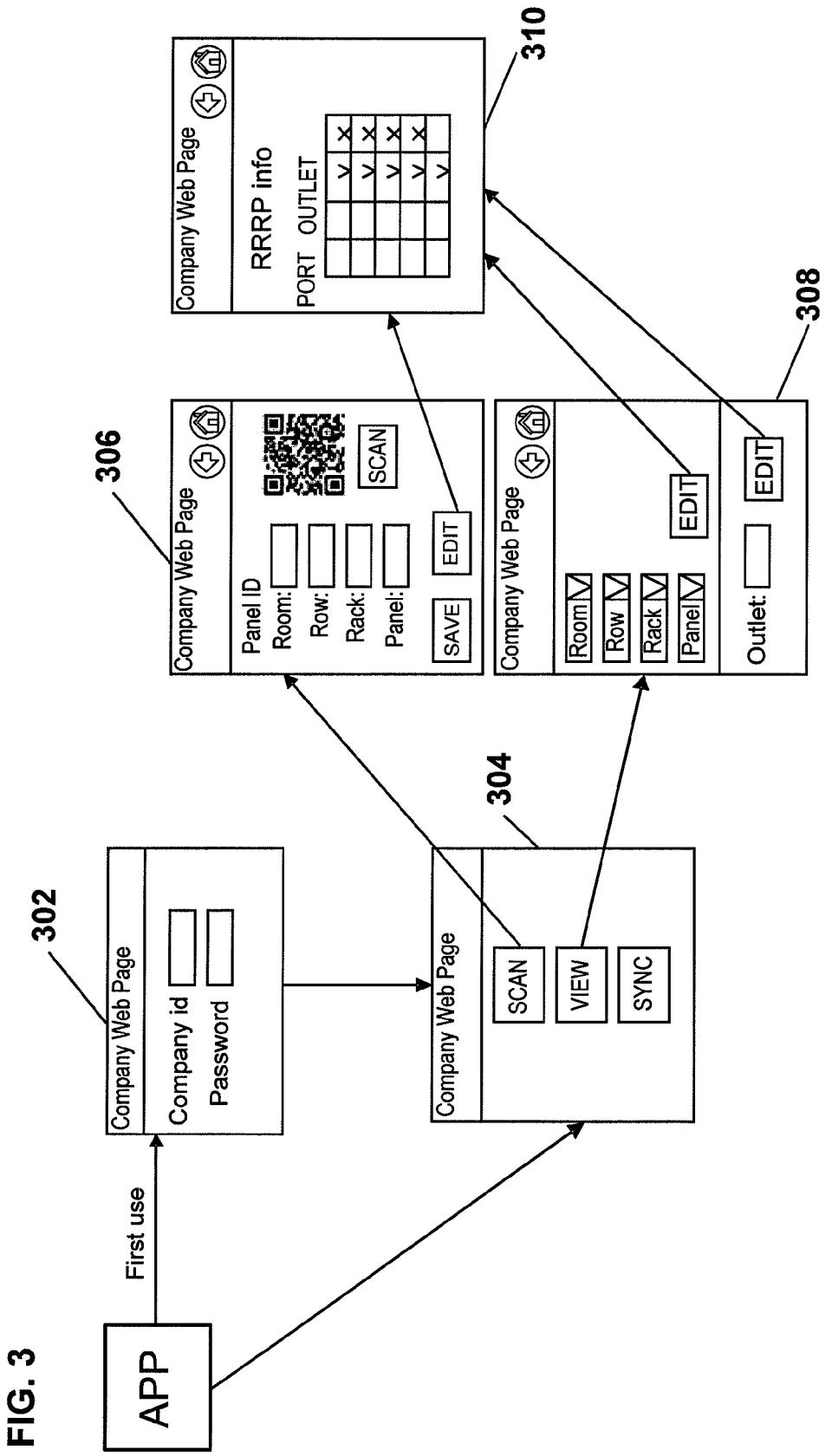
Scan

FIG. 2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Panel:
SCAN
SAVE
EDIT
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PORT OUTLET
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FIG. 3

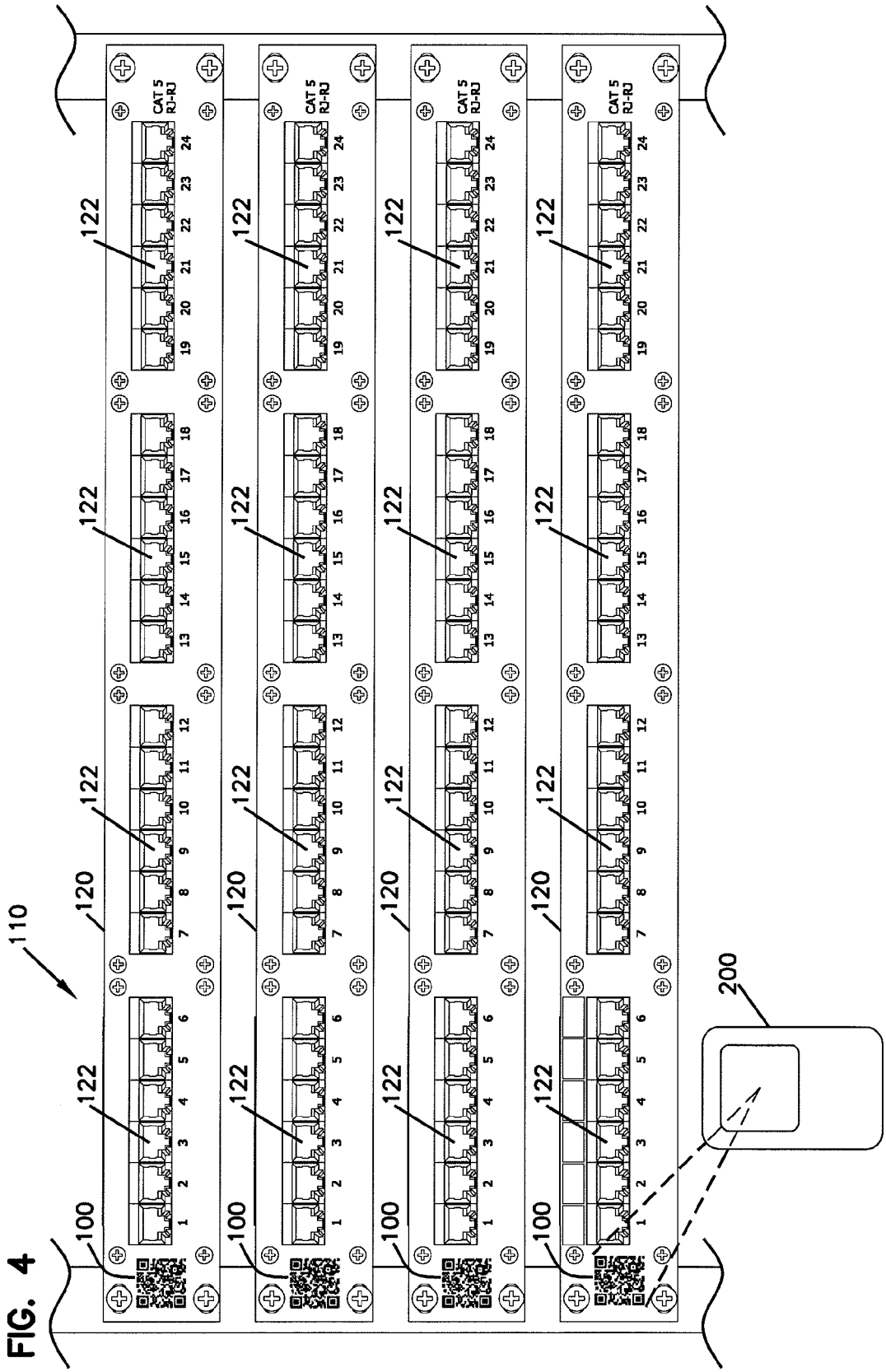

FIG. 4

COMPONENT IDENTIFICATION AND TRACKING SYSTEM FOR TELECOMMUNICATION NETWORKS

This application is being filed on 8 Nov. 2013, as a US National Stage PCT International Patent application No. PCT/US2012/038152, filed 16 May 2012 in the name of ADC Telecommunications, Inc., a U.S. national corporation, and Tyco Electronics Raychem BVBA, a Belgium national corporation, applicants for the designation of all countries except the U.S., and, Trevor D. Smith, a citizen of the U.S., and Danny Ghislain Thijs, a citizen of Belgium, applicants for the designation of the U.S. only, and claims priority to U.S. patent application Ser. No. 61/487,178 filed on 17 May 2011 and U.S. patent application Ser. No. 61/591,576 filed on 27 Jan. 2012, the disclosures of which are incorporated herein by reference in their entirety. To the extent appropriate, a claim of priority is made to each of the above disclosed applications.

BACKGROUND

Telecommunication systems typically employ a network of telecommunication cables capable of transmitting large volumes of data and voice signals. The signals can be transmitted over relatively long distances in a wide area network or a local network. The signals can also be part of a data communications network, such as in a data center of a building or a campus. The telecommunications cable can include fiber optic cables, electrical cables, or combinations of electrical and fiber optic cables. A typical long distance telecommunications network also includes a plurality of telecommunications enclosures integrated throughout the network of telecommunications cables. The telecommunications enclosures are adapted to house and protect telecommunication components such as splices, splice trays, termination panels, power splitters and wave length division multiplexers. Data centers include telecommunications equipment, storage systems, power supplies, and other equipment.

SUMMARY

The present disclosure relates to providing identification elements (e.g., tracking elements, tracing elements, locating elements, etc.) on various telecommunication components provided within a telecommunication network, such as a fiber optic network or a copper network. Example passive identification elements include bar codes (e.g., 2d barcodes) and radio frequency identification (RFID) tags. In certain embodiments, RFID tags are preferred over bar codes because they typically allow for significantly more information to be included therein. In certain embodiments, bar codes can be used to direct technicians to interne links at which additional information of the type described herein is provided. In certain embodiments, identification elements can be provided on telecommunication components through an application downloaded to a mobile device, such as handheld device, by scanning the bar code. Such application on the handheld device can then be used to manage the network connections, change the network connections, or check the status of the network connections. Multiple handheld devices can be used and synchronized together with a central application, website, or network. One example bar code useful for reading information from a network device and linking to a management application is a QR code.

A telecommunications system comprises a telecommunications component; and an identifying element on the telecommunications component, wherein the identifying element includes at least one of: information about connectivity of the telecommunications component, information about the telecommunications component, a link to a website, or a link to an application for downloading to a handheld device for managing the information about connectivity of the telecommunications component.

A method of using a telecommunications system comprises providing a telecommunications component; providing an identifying element on the telecommunications component, wherein the identifying element includes at least one of information about connectivity of the telecommunications component, information about the telecommunications component, a link to a website, or a link to an application for downloading to a handheld device for managing the information about connectivity of the telecommunications component; and scanning the identifying element.

The above noted systems and methods can also be used with any supporting hardware, such as hardware which supports, houses, or checks the equipment, including frames, racks, screens, cameras.

The above noted systems and methods and as further described and claimed can also be used with any type of network (copper or fiber) and whether the network is localized, or used or a wide area. The systems and methods can be used by the system operator for the equipment, the connections, and/or the supporting hardware, as desired.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is an example of a fiber distribution hub including a component identification system in accordance with the principles of the present disclosure;

FIG. **2** shows steps for using a component identification element in one implementation of the present disclosure;

FIG. **3** shows various steps in additional implementations of the present disclosure using a component identification element;

FIG. **4** is an example telecommunications rack including the plurality of patch panels.

DETAILED DESCRIPTION

Some telecommunication networks include a large number of components distributed over a large area. Often, the as-built configuration of a telecommunications network (e.g., a passive fiber optic network) differs from the configuration of the telecommunication network as originally planned. Because components of a given telecommunication network are spread out over a relatively large area, it can be difficult to track and confirm the as-built configuration of the telecommunications network. Similar problems exist in local networks, such as in data centers, where high density is desired.

The present disclosure relates to various systems and methods for maximizing the amount of data available for defining the as-built configuration of a telecommunication network. The present disclosure also relates to various methods and systems for utilizing as-built data to improve the reliability of telecommunication systems, to improve the ability to efficiently maintain telecommunication systems, and to improve the ability to efficiently upgrade telecommunication systems.

Certain aspects of the present disclosure relate to providing identification elements (e.g., tracking elements, tracing elements, locating elements, etc.) on various telecommunication components provided within a telecommunication network such as a fiber optic network or copper network. Example passive identification elements include bar codes (e.g., 2d barcodes) and radio frequency identification (RFID) tags. In

certain embodiments, RFID tags are preferred over bar codes because they typically allow for significantly more information to be included therein. In certain embodiments, bar codes can be used to direct technicians to network links, such as internet links at which additional information of the type described herein is provided. In certain embodiments, identification elements can be provided on passive telecommunication components such as: splitter modules; fiber optic connectors; fiber optic adapters; individual fiber optic adapters provided at a termination region; termination panels themselves; power splitter modules; individual outputs of power splitter modules (e.g., either connectorized outputs or non-connectorized outputs); multiplexers such as wavelength division multiplexers; individual outputs of multiplexing devices; fiber distribution hub housings; adapters used to interconnect with plug and play splitters; drop terminals; individual ports corresponding to drop terminals; ruggedized connectors that plug into drop terminals or elsewhere; single fiber ruggedized connectors; multi-fiber ruggedized connectors; individual fiber optic splices; splice trays; splice enclosures; parking modules; individual parking ports; fiber optic trays and drawers; wall boxes; receptacles for receiving parking modules; MTP/MFC connectors; and/or on other structures. Identification elements can be provided on active component as well.

Example parking modules are disclosed in U.S. Pat. No. 7,809,233 which is hereby incorporated by reference in its entirety. An example network interface device is disclosed in U.S. patent application Ser. No. 11/607,676 which is hereby incorporated by reference in its entirety. An example single fiber ruggedized connector is disclosed at U.S. patent application Ser. No. 12/203,508 which is hereby incorporated by reference in its entirety. An example splice tray is disclosed at U.S. application Ser. No. 12/425,241 which is hereby incorporated by reference in its entirety. Example fiber optic drawer/trays are disclosed at U.S. patent application Ser. Nos. 12/840,834 and 61/378,710 which are hereby incorporated by reference in their entireties. Example fiber optic enclosures are disclosed at U.S. Pat. Nos. 7,715,679; 7,756,379; and 7,869,682, which are hereby incorporated by reference in their entireties. An example aerial splice enclosure is disclosed at U.S. patent application Ser. No. 12/350,337 that is hereby incorporated by reference in its entirety. Example plug and play splitters are disclosed at U.S. Pat. Nos. 7,376,322; 7,593,614; 7,400,813; 7,376,323; and 7,346,254, which are hereby incorporated by reference in their entireties. An example drop terminal is disclosed in U.S. Pat. No. 7,512,304, which is hereby incorporated by reference in its entirety. An example ruggedized multifiber connector is disclosed at U.S. Pat. No. 7,264,402, which is hereby incorporated by reference in its entirety. Example fiber distribution hubs are disclosed in U.S. Pat. Nos. 7,873,255; 7,720,343; 7,816,602; 7,728,225; and U.S. patent application Ser. No. 12/827,423, the disclosures of which are hereby incorporated by reference in their entireties. An example splice closure is disclosed in U.S. Provisional Patent Application Ser. No. 61/468,405, which is hereby incorporated by reference in its entirety. In accordance with the principles of the present disclosure, identification elements can be incorporated into the various components of the systems disclosed in the above-identified patents and patent applications.

FIG. **1** shows an example fiber distribution hub (FDH) **20** having a component identification element in accordance with the principles of the present disclosure. The fiber distribution hub **20** includes an outer housing **22**. An FDH identifying element **22**A is provided on the housing **22**. In one embodiment, the identifying element **22**A is an RFID tag or a bar code. In the case of an RFID tag, the RFID tag can include various embedded information such as a photo of the FDH, an installation manual, information regarding FDH accessories, reorder information, and a specific identifying number for identifying the particular FDH.

The FDH **20** includes a termination field/panel **24** supporting a plurality of fiber optic adapters **26**. Each of the fiber optic adapters **26** includes first and second ports **28**, **30**. The termination field **24** has an identifying element **24**A corresponding to the field as a whole. Additionally, each of the fiber optic adapters **26** includes identifying elements corresponding to each of the first and second ports **28**, **30**. For example, each of the first ports **28** includes its own identifying element **28**A and each of the second ports includes its own identifying element **28**A.

The FDH **20** also includes a splitter module **32** containing a splitting component, such as power splitter or wave length splitter components. The splitting module **32** has its own identifying element **32**A. The splitting module **32** includes a plurality of outputs **34** (e.g., 16 pigtail outputs, 32 pigtail outputs, etc.). Each of the outputs **34** can include its own identifying element **34**A. If the outputs **34** are connectorized, the identifying elements **34**A can be provided on connectors **35** terminated to the ends of the outputs **34**. If the outputs **34** are not connectorized, the identifying elements **34**A can be provided directly on the pigtails routed out from the splitter module **32**. The splitter module **32** can also include an input **36** which can have its own identifying element **36**A. The input **36** can be connectorized or connectorized. In the case of a connectorized input, the identifying element **36**A can be provided on the connector. It will be appreciated that the splitter module includes components for providing a one to many optical connection. In the case of a power splitter, a signal input to the splitter module **32** by the input **36** is split in power and divided equally to the various outputs **34**. In the case of a splitting component in the form of a wave length division multiplexer, a signal input through the input **36** is split or divided based on wave length and signals within predefined wave length ranges are transmitted to the various outputs **34**.

Referring still to FIG. **1**, the FDH **20** also includes a plurality of optical fibers **40** having ends that are connectorized by connectors **42**. The optical fibers **40** can be optically connected to various subscriber locations via distribution or drop cables. Each of the connectors **42** can include its own identifying element **42**A.

It will be appreciated that the outputs **34** of the splitting module **32** can be plugged into the first ports **28** of the fiber optic adapters **26** and the connectors **42** corresponding to the optical fibers **40** can be inserted into the second ports **30** of the fiber optic adapters **26**. In this way, the fiber optic adapters **26** are used to optically connect the outputs **34** of the splitter module **32** to the optical fibers **40**. This allows subscribers to be optically connected to the fiber optic network.

In certain embodiments, the identifying elements corresponding to the fiber optic connectors can include various information about the connectors. Example information includes: a unique identification number; test results from final factory validation testing (e.g., end face geometry, insertion loss information, return loss information), warranty information, installation information, accessories information, re-order information, or other information.

In certain embodiments, the FDH **20** can include a splicing region **48** including one or more splice trays. Each of the splice trays can include its own identifying element. It will be appreciated that splices are held within the splice tray. It will be appreciated that each of the splices can have its own identifying element. Similarly, each of the fibers connected

by a given splice can have there own identifying element. The splicing region **48** can be used to splice the fibers **40** to outgoing distribution cables routed to subscriber locations. A further splice region **49** can be provided for splicing the feeder fibers to the splitter inputs. Identifiers can be provided at each of the splice trays and can also be provided for each of the incoming and outgoing fibers routed to the spliced trays.

The FDH **20** also includes a connector storage location **60** having parking modules **62** with module identifiers **62**A. The parking modules include ports/receptacles **64** for receiving individual connectors (e.g., connectors **35**). The modules and each of the ports can include individual identifying elements **64**A.

In practice, the FDH **20** is installed by a technician in the field. During the installation process, a technician can use a handheld scanner to scan the FDH identifying element **22**A. The scanning element can also access positioning data (e.g., global positioning coordinates) corresponding to the location the FDH **20** is being installed. In this way, by scanning the FDH identifying element **22**A, the exact geographic position at which the FDH has been installed can be saved and later downloaded into a database recording the as-built configuration of the telecommunications system. Scanning of the identifying element **22**A can also provide the technician with necessary installation information, such as installation manuals or other materials. The scanning ties a unique identifying number assigned to the FDH **20** with a particular geographic position at which the FDH **20** has been installed. Information relating to the technician (e.g., identification, training record) can also be saved and linked to the given installation at the time of the scan.

As the technician continues the installation process, the technician plugs the outputs **34** into the first ports **28** and also plugs the connectors **42** into the second ports **30**. During this installation process, the technician can scan the identifying elements **34**A corresponding to the splitter outputs and the identifying elements **28**A corresponding to the first port. In this way, information can be saved into the as-built database showing exactly which outputs **34** are plugged into exactly which first ports **28**. Specifically, specific identifying numbers corresponding to each of the outputs **34** are tied to corresponding identifying numbers corresponding to each of the first ports **28**. In certain embodiments, the identifying elements **34**A and the identifying elements **28**A are scanned separately. In other embodiments, the identifying elements **34**A and the identifying elements **28**A are required to be scanned together or can be scanned together to reduce the likelihood of error in the scanning process. In a similar way, the technician can scan each of the identifying elements **42**A and each of the identifying elements **30**A to record a record of exactly which connectors **42** are inserted into which second ports **30**. In this way, identification numbers corresponded to each of the connectors **42** are linked to corresponding identification numbers corresponding to each of the second ports **30** so that an accurate as-built data base can be generated. Similarly, information linking specific storage ports **64** to specific outputs **34** can be scanned and saved.

In certain embodiments, the scanner/RFID reader can be a separate piece of equipment. In other embodiments, the scanner/RFID reader can be incorporated into a cellular phone or tablet, or can be an add-on to a cellular phone or tablet. Other information that can be recorded includes: the name of the technician conducting the installation; technician training records; and the time at which each operation was conducted.

Example information that can be included in the identification elements (e.g., RFID tags) which would be available to the customer/technician upon accessing the information on the identification element include:

Information List No. 1
Test results (IL, RL, geometry, etc.)
User manuals and videos
Re-order information
Ancillary products
Product pricing and availability
Warranty information
Product recall notices
Extended warranty offers
LSL information
Installation date and technician

Scanning the identification elements can generate the following information:

Information List No. 2
Installation rates—actual consumption
End user information
Installation locations—GPS coordinates
Actual installer name and training records
Verify improper use of LSL items
Frequency of use/visit
Automated record keeping

At least some of the information outlined above can be used for implementing product warranties. For example, warranties could be started by the product seller when the product is actually installed in the field. The information derived from the scanning operation can be used to confirm that all product was be installed by a certified installer and suitably scanned upon installation. Violation of this could void the warranty. An application (e.g., a Smartphone application) can be developed that verifies training records of installer, records installation location; determines installation rate used an input to demand prediction, as a locator for any warranty concerns; and to bring extended warranty information to customers as records indicate warranty runs out. Registered users can become part of a seller database of customer contacts—allows follow-up on ease of use.

The above-description includes an example implementation of component identification elements included in a fiber distribution hub (FDH) **20**. Various other telecommunications equipment and cable management systems and networks are anticipated for use with one or more component identification elements. For example, the identifying elements can be utilized in a data center including an identifying element associated with each patch panel. Identifying elements can be associated with each port of the patch panel and each patch cord connected to the patch panel if desired. Fiber or copper cables can be used in the data center. One example copper patch panel is disclosed in U.S. Pat. No. 6,504,726 which is hereby incorporated by reference in its entirety.

With reference to FIG. **2**, one specific implementation of an identifying element, which is useful in a data center, on a fiber distribution hub, or in other telecommunications systems and networks, is a 2d bar code in the form of a QR code. The QR code can be scanned at step **202** by a handheld device (e.g., cell phone) by the technician, which can then direct the technician to a company's website at step **204**. The company's website can be the product manufacturer's website or the user's website. The QR code can also link to one or more of the items in the Information List No. 1 above. The QR code could also be coded to include one or more of the items in the Information List No. 1 above.

The QR code can also direct the technician to download an application for use with the handheld device in managing the telecommunications equipment at step **206**. At the same time the technician downloads the application, the technician can

also request or enter a company identification code and/or user specific identification code at step **208**. These steps are illustrated in FIG. **2**.

Referring now to FIG. **3**, once the handheld device includes the application, the QR code **100** of the network device (e.g., patch panel) can be scanned and the technician can enter the company ID, and the password if necessary, at step **302**, to begin implementation of the application. If the handheld device is already linked to the user, the user can begin the application to manage the network device at step **304**.

The QR code gives the technician a tool to maintain connection information for their network connections in a data center, such as the network connections between patch panels **120**, of the type shown in FIG. **4**. Instead of scanning all of the connections, the technician can enter them manually into the handheld device to document the network connections.

Each patch panel **120** will be labeled with a unique QR code **100**. In one preferred embodiment, the QR code will contain a URL and a unique ID. The URL will bring the technician to a website where the technician can see installation instructions or other information about the network. The application will give the technician the possibility to maintain the port **122** connections for all the patch panels **120** adjacent to the scanned panel **120**.

The first time that the technician starts the application, the application preferably requests a company identification and a password at step **302** of FIG. **3**. Once the handheld device is linked to the website, the technician will be able to identify the panel at step **304**. In one implementation, the panel information can include information such as: 1) a room number, 2) a row number, 3) a rack number, and 4) a panel number as shown in steps **306** and **308**. Together with the unique ID, and the QR code of the panel, this information will be stored locally on the handheld device. This information can be uploaded to the network or main storage device.

At a later date, when the technician reads the QR code on the patch panel **120**, the technician will see the port information on the handheld device. The port information can be updated if the technician makes a change in the connections between the ports **122** at step **310**. Scanning the QR code and/or updating the information can update the items in the Information List No. 2 above.

In one application, the technician can view existing connections between ports **122** to make a manual check and verification of the connections.

The technician can also synchronize the handheld device with other handheld devices and also to the home network database so that the full network information is current.

A further application of the component identification and tracking system for telecommunication networks includes situations where internet and/or cell service is unavailable. The technician can utilize the QR code to access information stored on a handheld device. If the technician then makes changes to the network connections, the information can be entered on the handheld device and later synchronized with the main network or other handheld devices for updating the main database.

A still further application of the present invention includes situations where the QR code includes the actual connection data of the network connections. Such information might be useful when there is no internet or cell coverage where the technician is accessing the network. If the technician reads the QR code and reads the network connections, the technician is able to see a current status of the network connections. If a change is made by the technician, the technician can enter the change on the handheld device, and print out a new QR code on a portable printer. The new QR code is left on the network device, and the previous code is removed or covered up since it is now out-of-date. In this manner, a technician can access network information merely by reading the QR code, and updating the QR code to reflect changes.

Within the present invention, various passive identification elements can be utilized including the noted barcodes and the radio frequency identification (RFID) tags. Barcodes can be one dimensional or two dimensional. More information is capable of being stored on the two dimensional bar codes, such as the noted QR codes. The information can be transferred to other network devices for network management, especially for larger networks where multiple technicians may be managing the network connections.

Parts List

20 fiber distribution hub
22 outer housing
22A identifying element
24 termination field/panel
24A identifying element
24 splitter module
26 fiber optic adapters
28 first ports
28A identifying element
30 second ports
30A identifying elements
32 splitter module
32A identifying element
34 outputs
34A identifying element
35 connectors
36 input
36A identifying element
40 optical fibers
42 connectors
42A identifying element
48 splicing region
49 splice region
60 connector storage location
62 parking modules
62A module identifiers
64 ports/receptacles
64A individual identifying elements
100 identifying element
110 data center
120 patch panel
122 port
200 handheld device
202-208 initiation steps
302-310 usage steps

The invention claimed is:

1. A communications system configured to carry communications signals over a communications network, the communications system comprising:

a communications component of the communications network;

an identifying element disposed at the communications component; and

a mobile device that is configured to scan the identifying element;

wherein the identifying element includes information about connectivity of the communications component, information about the communications component, a link to a website, and a link to an application for downloading to the mobile device for managing the information about connectivity of the communications component;

wherein the mobile device also is configured to communicate the information about connectivity to the management network.

2. The communications system of claim **1**, wherein the identifying element is an RFID tag.

3. The communications system of claim **1**, wherein the identifying element is a bar code.

4. The communications system of claim **3**, wherein the bar code is a two dimensional barcode.

5. The communications system of claim **4**, wherein the two dimensional barcode is a QR code.

6. The communications system of claim **1**, wherein the communications component is configured to receive an optical fiber that carries the communications signals.

7. The communications system of claim **1**, wherein the communications component is configured to receive an electrical cable that carries the communications signals.

8. The communications system of claim **1**, wherein the communications component includes a plug connector.

9. The communications system of claim **1**, wherein the communications component includes a structure defining a port to receive a plug connector.

10. The communications system of claim **1**, wherein the information about the communications component includes test results.

11. The communications system of claim **1**, wherein the information about the communications component includes user manuals.

12. The communications system of claim **1**, wherein the information about the communications component includes reorder information.

13. The communications system of claim **1**, wherein the information about the communications component includes product pricing and availability.

14. The communications system of claim **1**, wherein the information about the communications component includes warranty information.

15. The communications system of claim **1**, wherein the application for managing the information enables a user to manually enter network connections made at the communications component.

16. The communications system of claim **1**, wherein the mobile device is configured to locally store information obtained from scanning the identifying element and to communicate the information about the connectivity to the management network at a subsequent time.

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